Summary of Changes in

ASME Section IX, 2010 Edition, 2011 Addenda

As published in the *Welding Journal*, November, 2011
Pages 61 through 63

Prepared by

Walter J. Sperko, P.E.
Sperko Engineering Services, Inc
4803 Archwood Drive
Greensboro, NC 27406   USA
Voice: 336-674-0600
FAX: 336-674-0202
e-mail:sperko@asme.org
www.sperkoengineering.com

The following is a summary of the changes that appear in 2011 Addenda to the 2010 Edition of ASME Section IX. Significant changes and related discussion are reported by Walter J. Sperko, P.E., Chairman of ASME BPV Standards Committee IX; all changes, including editorial corrections which are not usually mentioned in these articles, are readily identified in the "Summary of Changes" which begins on page (xxviii) of the Addenda. Readers are advised that the opinions expressed in this article are those of Mr. Sperko and not the official opinion of BPV Standards Committee IX. These changes become mandatory January 1, 2012.

Administrative Changes

The 2011 addenda are the last addenda that the ASME Boiler and Pressure Vessel Code will issue. There will not be 2012 addenda, and as of 2013, the Code will be published biennially -- without addenda during intervening years. That means that you will no longer be spending time in front of the tube inserting addenda. Alleluia! Errata and corrections will be posted at http://www.asme.org/kb/standards/publications/bpvc-resources so that Code users can readily see revisions and corrections. We should also expect to see more use of Code Cases to provide interim rules between editions so that new technology can be implemented in a timely manner without waiting for publication cycles; these will be posted at the same site. ASME has advised that the price of Code books will be adjusted to be "revenue neutral" -- exactly what that means remains to be seen.

Another administrative change is to allow materials that are not permitted for Code construction to be assigned P-numbers. See the discussion under materials.

Welding Procedure (QW-200) Changes

QW-161 on preparing bend test specimens has been revised to require that additional specimens be removed when the width of the weld and the heat-affected zone (HAZ) are so wide that both sides of the weld and HAZ cannot included in a each specimen. For materials that use the standard bend radius of 3/4 inch and side bend specimens that are 3/8 inch thick, this occurs when the width of the weld and HAZ exceeds about 4.7 inches. Allowing 1/4 inch for the HAZ on both sides, a cover pass that is over 4-1/4 inches wide would require that multiple bend test specimens be prepared and tested – assuming that the weld is exactly centered on the specimen after testing. When multiple specimens are necessary, all the specimens needed to include the weld and HAZ are a set and represent one required bend test.

Diffusion welding, which was previously approved by Code Case for Section III and VIII heat exchangers, was added to Section IX for any application. In a typical heat exchanger application, sheets of stainless steel or similar corrosion-resistant alloy are etched or machined to form channels in the sheet, then the sheets are stacked so that the channels on each layer are laid out perpendicular to the previous layer. Typically hundreds of sheets are stacked with heavy plates on the top and bottom, placed into an atmosphere-controlled furnace and held at elevated temperature for a specified time. During that time, atoms from each plate surface diffuse into the neighboring plate surfaces to form a single-piece block. After cooling to room temperature, covers are welded to each of the four surfaces with the channels to allow gas or other fluid to flow through the channels resulting in a very efficient and compact plate-type heat exchanger.

Diffusion welding qualification consists of welding a minimum 25 sheets without channels plus a top and bottom plate to form a solid block 8 inches square. Three tension tests are performed in the sheet area perpendicular to the sheet interface and three more are performed parallel to the sheet interface. Finally, three cross-sections are prepared and examined metallographically. This test qualifies all sizes and number of layers of sheet and may be used for any application, not just heat exchangers.

There were major changed is the variables for procedures and qualification for laser beam welding (LBW). The prior rules were conservative since the industry had little experience with LBW when they were written in the 1980s. The revisions reduce the number of qualifications that are typically required and tighten up some aspects. For example,

- The joint design to be used is limited to that qualified.
- The base metal thickness qualified now has only a maximum qualified thickness instead of a minimum and a maximum.
- filler metal is no longer limited to the specific chemical composition qualified as long as it is the same F-number and A-number.
- a tolerance of ±10% has been added to oscillation width, frequency and dwell time and to beam pulsing frequency and duration.
- a tolerance of 10° has been added to the angle of the beam relative to the workpiece surface.
- The type of equipment is no longer an essential variable, but additional variables have been added to address the type of laser (YAG, CO2, etc.), beam optics and gas.

QW-409.1, which was revised heavily last year to incorporate waveform controlled heat input measurement, was corrected for both instantaneous energy formulae. In the 2010 edition, the divisor “weld bead length” units were shown as “[in/min]” in one formula and “[in (min)]” in the other. Both should have read [in. (mm)]. This correction was by errata which means that it is retroactive.

In related changes, QW-409.26 and QW-409.29 were editorially revised to coordinate better with the methods for determining heat input based on QW-409.1 formulae. These variables only apply to corrosion-resistant overlay and temper bead welding.

The bend test fixture dimensions in QW-466.1 have been revised – but only the metric units are changed. Previously the metric dimensions were converted from US customary units resulting in a 10 mm thick test specimen wrapping around a 38.1 mm diameter mandrel. The revision changes the dimension to the correct mandrel diameter of 40 mm based on the specimen thickness of 2t. Similar corrections were made for all other materials shown in the table.

Welder Qualification (QW-300) Changes

QW-300.3 on "mass qualification" of welders was revised to specifically allow the use of AWS Standard Welding Procedures where they are permitted by QW-500. Minor changes were made in QW-500 to recognize that ultrasonic examination ("volumetric") could be used to test the demonstration test coupon in addition to radiography and bend test.

Base Metals and Filler Metals

The paragraph addressing the column in the P-number table regarding ISO 15608 and what it is about was finally printed in the current edition; it had been accidentally omitted since the ISO 15608 column was added in 2009.

A number of new materials were added to the P-number tables (see page xxix for a list) and various corrections were made by errata.

Filler metals ERNiCr-7; ERNiCrFe-13 and ERNiCrMo-22 were assigned F-number 43.

Updated versions SFA-5.01, *Filler Metal Procurement Guidelines* and SFA-5.22, *Stainless Steel Flux Cored and Metal Cored Electrodes and Filler Metal* were added to Section II, Part C. There is a change in the philosophy regarding the location of metal cored wires in the filler metal specification that has come from the ISO world that is evident in SFA-5.22; it now covers metal cored electrodes which were previously covered in SFA-5.9. While this change in location of filler metals does not change the qualification ranges (i.e., solid and metal cored wires are still interchangeable), WPSs that permit the use of both solid wire and metal cored wire have to be revised to show both the solid wire and the cored wire specifications. That is, if your current WPS for GTAW using SFA-5.9 ER308L filler metal allows the use of both solid and metal cored filler metals, it will have to be revised to add provisions to use SFA-5.22 and EC308L designations if the WPS will continue to permit metal cored filler metal. This change will also occur for the carbon and low alloy steel wires as the ISO versions of those filler metal specifications are adopted.

The biggest change in these addenda was addition of Appendix J, *Guideline for Requesting P-Number Assignments for Base Metals Not Listed in QW/QB-422*. Previously it was required that a material had to be approved for use in either the *ASME Boiler and Pressure Vessel Code* or in the *B31 Code for Pressure Piping* for it to be assigned a P-number. The new appendix states that the committee will consider assignment of all materials listed in ASME Section II Parts A and B, and it will consider materials manufactured to other recognized national or international standard. It provides the following list of information to be provided:

- The product application or intended use
- The material specification, grade, class and type as applicable
- The mechanical properties and chemical composition requirements
- Welding or brazing data such as: comparable materials already assigned a P-number; published welding or brazing data; typical BPSs or WPSs and PQRs
- Properties of welded or brazed joints if less than the minimum specified in the applicable materials specification.

The information required for a material to be assigned a P-number is not as extensive as that required for materials to be considered for Code construction, it is recommended that anyone requesting a P-number assignment review ASME Section II Part D, Mandatory Appendix 5 posted at http://files.asme.org/asmeorg/Codes/Publications/BPVC/10680.pdf for more details about the information that is required in order for materials to be adopted by the Code. The new appendix emphasizes that the assignment of a P-number to a material does not mean that that material is permitted to be used for Code Construction; however, having a P-number assigned to a non-Code material will simplify the qualification process for welding on materials that are outside the jurisdictional boundary of the Code, such as supports, heat transfer attachments and even pressure parts when such parts are part of non-code items (e.g., stop valves on a turbine) and are made using non-ASME materials. The appendix also provides details for submittal of the request to the committee.

If base materials that have not been approved for Code construction can now be assigned P-numbers, how about filler metals? Section II Part C, page xxviii has guidelines for getting materials listed in Section II, Part C, and once they are in Section II, Part C, they can be assigned F-numbers. The requirements are different from those for base metals, however. Filler metals have to be manufactured to recognized national or international standards to be adopted, and the organization that publishes the standard has to agree to allow ASME to publish their standard in Section II, Part C. Other than that, the information required to be submitted is somewhat more detailed that that listed above, plus any licensing issues must also be disclosed.

Note that filler metals do not have to have an F-number or be listed in Section II, Part C in order to be used for Code construction, including construction of pressure-retaining parts; such filler metals simply need to be qualified by being used in a procedure qualification test coupon, and the resulting WPS must limit the material to the manufacturer's trade name or other unique designation that identifies that filler metal.

Brazing (QB) Changes

No significant changers were made in the brazing rules

Inquiries

There were no exciting inquiries published in this round, but the question of what should one write down on the PQR for the heat input on a multi-pass weld when the pass heat inputs are different has become a common question that deserves some discussion. QW-409.1 clearly specifies that the heat input recorded on the PQR is the maximum heat input that the WPS may permit.

The existing interpretations are not a lot of help. Interpretation IX-04-14 says that the heat input calculated has to be based on the volts, amps and travel speed in the same unit of weld length, so the volts, amps and travel speed for each pass or each electrode is used to calculate the heat input for that pass or electrode. Interpretation IX-81-19 says that the average heat input of all the passes does not have to be calculated and become the heat input qualified, but it also says that you do not have to record the heat input for each pass on the PQR. It is, however, appropriate to record the heat input for each pass in your records; I use a spreadsheet that is posted on my web site to do that so I can review it to establish the heat input that I will enter into my PQR.

Let's look at some ways to calculate the heat input you could put down on the PQR

ASME Section IX does not tell you what value to pick (min, max, average or other) for the qualified heat input, but you should keep in mind that whatever value you enter on the PQR is the maximum heat input that the welder is permitted to use, and the WPS has to reflect that fact.

If you take the lowest heat input that you recorded on your spreadsheet, that does not approach the heat input that was used on the test coupon – obviously unreasonably conservative. If you take the average or mean heat input of *all* the passes, roughly half of those values will be above the average heat input – and half of them below. That means that the heat input that the welder could use would be less than half of the heat input that was used on the test coupon – again unreasonably conservative, and the welder may have a hard time welding with such low heat input.

Finally, if you scan the spreadsheet and find the pass that exhibited the maximum heat input, that pass may be significantly higher than the heat input for any other passes – this heat input would not reflect the heat input generally used on the test coupon. On the other hand, if the highest heat input value was in a cluster of similar heat input, that might be a reasonable values to enter on the PQR for the maximum heat input qualified.

I use the attached spreadsheet to record the volts, amps, travel speed, deposit length per unit length of electrode (for SMAW only), bead size, etc. and to calculate the heat input. I also calculate the average heat input and the standard deviation of the heat input for each process used to weld the coupon. I then look at the heat input numbers for each pass for each process, and if they are pretty uniform (standard deviation is small, see Figure 1), I find the highest one and put that down on my PQR as the maximum. If there is a wide range (big standard deviation), I put down the third or fourth highest heat input value as my "qualified maximum" heat input. This throws out any extreme outliers that are not representative of the test coupon maximum heat input.

An even more sophisticated approach is to compute the average heat input and the standard deviation for all passes using spreadsheet software. If you take the average heat input plus 1.23 standard deviations above the average and call that your maximum heat input qualified, 90% of the heat input values in your spreadsheet will be below that value, neatly throwing out significant outliers and provides a reasonable upper limit value for your PQR. See Figure 2. Using the mean plus 1.65 standard deviations would make that 95%.

Figure 1
A Normal Distribution Curve Showing Standard Deviations from the Average and the percentage of population in each segment.

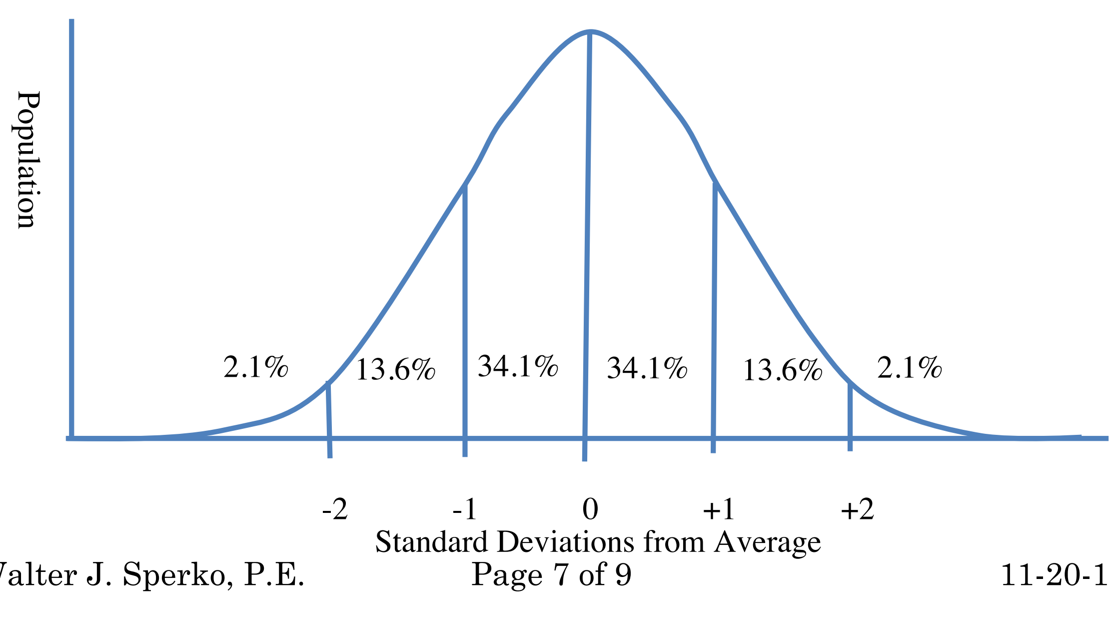
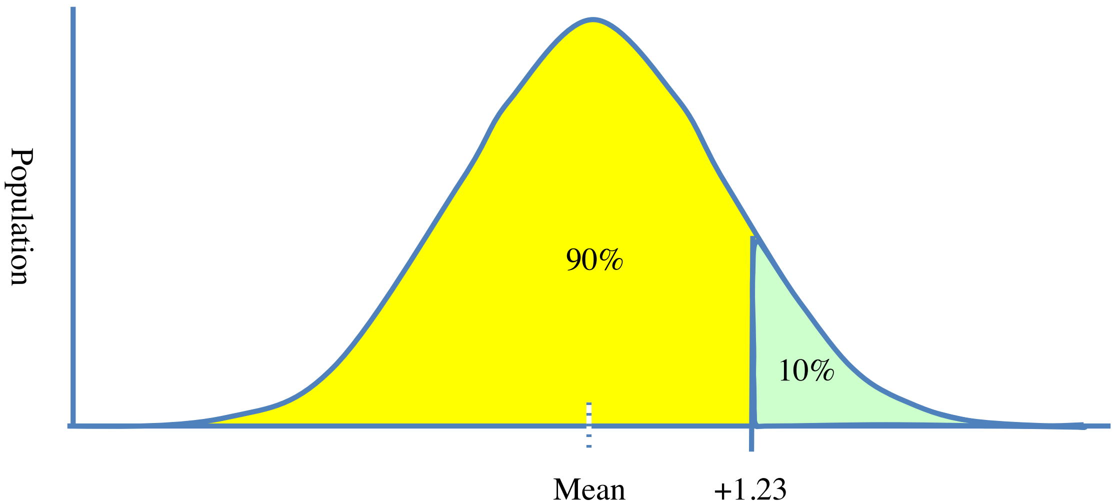


Figure 2

Normal Distribution Curve Showing the Percentage of Data Points
On Each Side of the Mean plus 1.23 standard deviations above the mean



Bottom line is that what you enter on your PQR is your call based on your numbers, but keep in mind that what you put down on the PQR is going to be the maximum heat input permitted in the WPS and the value you choose should recognize the consequences of that fact.

Coming Attractions

As I mentioned in my previous summary, a whole new section on joining plastic is being prepared. While the current effort is to write rules for joining HDPE using the hot plate method, the formatting is such that other methods will be able to be added at later dates. Since addition of plastic will bring a third section into Section IX, there is a plan to put all the common administrative rules into their own section, so the 2013 edition should be less redundant, less cluttered and – hopefully – easier to use.

Where the A-number table of weld metal chemical composition presently has three dots (ellipses) for some elements there will single values added indicating a maximum amount of that element in the weld metal. The new values are based on the limits on these elements that are found in the SFA specifications.

Readers are advised that ASME Code Committee meetings are open to the public; the schedule is available on the writer's web site and at www.asme.org.

Mr. Sperko is President of Sperko Engineering, a company that provides consulting services in welding, brazing, metallurgy, corrosion and ASME Code issues located at www.sperkoengineering.com. He also teaches publicly offered seminars sponsored by ASME on how to efficiently and competently use Section IX. He can be reached at 336-674-0600 and by e-mail at: sperko@asme.org.